Tilburg University

Indirect taxation in developing countries

Bovenberg, A.L.

Published in:
IMF Staff Papers

Publication date:
1987

Link to publication in Tilburg University Research Portal

Citation for published version (APA):
Bovenberg, A. L. (1987). Indirect taxation in developing countries: A general equilibrium approach. *IMF Staff Papers*, *34*(2), 333-373.

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 06. May. 2023

Indirect Taxation in Developing Countries

A General Equilibrium Approach

A. LANS BOVENBERG*

Indirect taxes are an important element in stabilization tax packages that aim to raise revenue in the short run. This paper evaluates, by using a general equilibrium model, alternative instruments of indirect taxation in middle-income developing countries. It uses data for Thailand as an illustration and examines the effects of these instruments on revenue, efficiency, equity, and international competitiveness. The paper shows that the interaction between taxes and the distortions caused by various policies can be important for revenue and efficiency. It also reveals significant backward shifting and a link between outward-looking supply-side tax policies and trade policies in industrial countries.

TAX POLICY PLAYS an important role in the efforts of many middle-income developing countries to improve their fiscal and economic performance. In the short run policymakers formulate tax packages to complement expenditure restraint aimed to contain macroeconomic imbalances. Revenue mobilization through taxation is also an important element in medium-term development plans that aim to raise domestic investment and government savings while reducing reliance on debt-creating capital inflows. The need for increased fiscal revenue, however, has to be reconciled with the other objectives of economic policy, such

* Mr. Bovenberg, an economist in the Fiscal Affairs Department, is a graduate of Erasmus University in Rotterdam; he received his Ph.D. from the University of California at Berkeley. The author thanks Shanta Devarajan and Hecktor Sierra for providing data and Wouter Keller for providing computational assistance.

as efficient resource allocation, equitable income distribution, and a competitive trade sector.

This paper assesses alternative indirect tax instruments in developing countries in light of these objectives. To do so, the paper adopts a general equilibrium approach. In contrast to the partial equilibrium approach, which is typically adopted in assessing taxes, a general equilibrium approach accounts for the interactions among various markets and taxes. These relationships are potentially important for policy. For the revenue and efficiency objectives of policy, for example, a general equilibrium approach can explore how various taxes and other distortions interact in determining tax revenue and distorting behavior. An important theme in the paper is the effects that domestic taxes on goods and services have on both revenue collected from, and distortions induced by, other tax instruments, especially trade taxes. Thus, despite its limitations, the general equilibrium approach represents an advance over other methods by offering a unifying framework that can highlight channels of interdependence that a partial analysis would not uncover.

This study focuses on indirect taxation—taxes on goods and services, and on international trade—for three reasons. First, middle-income developing countries rely heavily on these taxes. Second, the indirect tax structure is a potential area of reform in many of these countries. The efforts of some of these countries to liberalize trade policy require a shift away from trade taxation toward taxation on domestic consumption. Existing systems of taxation on domestic consumption in these countries often incorporate some undesirable features as well. Third, in the interest of raising revenue in the short run, stabilization tax packages often contain measures pertaining to indirect taxes.[1]

The paper uses, as an illustration, data for Thailand. That country provides an interesting case for the study of indirect taxation because certain characteristics of its indirect tax structure, such as cascading and the reliance on trade taxes, apply to many other developing countries as well.

The paper contains three sections. Section I introduces the applied general equilibrium methodology and describes the main features of the particular model that is applied. Section II contains results derived from the model simulations. The reader who is mainly interested in the policy implications can skip this section. The major lessons and policy implications from this study are drawn together in Section III.

[1] For the tax content of stand-by arrangements, see Beveridge and Kelly (1980).

I. A Computable General Equilibrium Model

This section first introduces the computable general equilibrium approach and discusses its weaknesses and strengths in analyzing tax policy. The section then describes the particular model applied in this paper and elaborates on some limitations of the model.

The Computable General Equilibrium Framework

Computable general equilibrium analysis explicitly specifies the interactions among rational economic agents, markets, and public policy within a consistent macroeconomic framework. In general the models used in this analysis incorporate several industries, households, goods, and factors as well as international trade flows. Thus they account for both macroeconomic constraints and the links between various industries and domestic and international markets. General equilibrium modeling is firmly rooted in the clearly specified theoretical framework of microeconomic theory; the decisions of the decentralized agents are based on optimizing behavior and basic parameters of taste and technology. In most models relative prices are endogenous and play a crucial role; they equilibrate demand and supply in all markets. Shoven and Whalley (1984) have surveyed recent applications of the general equilibrium methodology. Bovenberg (1985) has evaluated the significance of general equilibrium modeling for public policy.

General equilibrium modeling has many limitations. The economic richness of the models does not allow for the simultaneous estimation of all parameters. Therefore most modelers "guesstimate" the parameters on the basis of econometric estimates from the empirical literature. Moreover, the models adopt many simplifying assumptions, such as perfect competition and flexible prices. Taking into account the weaknesses of the models, the policymaker should interpret the quantitative results only as indicative of the rough order of magnitude of policy effects, given particular assumptions about economic behavior and about political and institutional responses. Although it is assumed that the model solutions exert a certain pull on the economy, the simulations should always be supplemented with what the analyst believes and knows about the economic, institutional, and political world and about how that complex real world relates to the stylized model. Thus the simulation results should induce policymakers to start, rather than stop, thinking.

Despite the limitations, the general equilibrium approach offers a useful unifying framework relative to other methods of studying the relationship between tax policy and the objectives of revenue, efficiency, equity, and international competitiveness. With respect to the revenue objective, the general equilibrium framework forces policymakers to consider the constraints imposed by rational microeconomic behavior. The framework models the erosion of the tax base from substitution away from taxed commodities by rational agents. It also estimates the consequences of the behavioral response to a particular tax for the bases of other taxes.

As regards efficiency, general equilibrium modeling is particularly useful for welfare analysis in a distorted (second-best) economy because it simultaneously specifies the various tax distortions and is based on optimizing behavior. Thus the framework can be used to explore how taxes interact with existing distortions in affecting rational behavior. An important theme in this paper, for example, is the effect that domestic taxes on goods and services have on both revenue collected from, and distortions induced by, other tax instruments, particularly trade taxes.

With respect to the equity objective, because general equilibrium models incorporate several household sectors, these models can study the effects not only on economy-wide efficiency but also on welfare enjoyed by each disaggregated household. This study focuses on the distribution between rural and urban sectors and between the national economy and the rest of the world.

In the study of the incidence of taxation, partial equilibrium approaches usually assume that both the intermediate and final components of the sales and excise taxes are fully shifted forward toward final demand. The general equilibrium approach, in contrast, makes no prior assumptions about the shifting of a tax but endogenously determines the tax shifting. The next section shows that, depending on the structure of the economy, taxes on goods and services may be (partially) shifted backward.

As regards structural adjustment and the objective of international competitiveness, the general equilibrium framework models the effects on exports, competing imports, and complementary imports in each sector of an economy. How taxation affects the trade orientation of an economy—that is, the mix of export-oriented, import-dependent, nontradable, and import-competing industries—can be studied by disaggregating the industries accordingly.

A Particular General Equilibrium Model

This paper uses a general equilibrium tax model developed in Keller (1980).[2] This subsection gives a broad overview of the model's structure,

[2] This study used the computer software "The Keller Model, Free University of Amsterdam, for IBM-PC," which was kindly provided by W.J. Keller.

including its limitations and underlying assumptions. The Appendix contains an algebraic presentation of the model.

Following Johansen (1960), the model adopts log-linear approximations of all—possibly nonlinear—relationships around the initial situation and is solved in percentage changes of the variables. Thus the solutions describe the marginal effects of changes in taxes. They can also be used, however, as linear approximations for larger changes.[3]

This study adopts a comparative static approach: it compares medium-run equilibria before and after a change in tax policy. General equilibrium models are not designed to simulate short-run changes because behavior and prices may adapt slowly. The reference period, defined as the period for which the results become valid, is about three years.[4] This is a period sufficiently long for prices and behavior to adjust. It is also a period sufficiently short so that changes in the stocks during the period are small compared with the level of the stocks; the static model ignores induced changes in stocks, such as the accumulation of capital stocks.[5]

To simulate the changes in the structure of production that are induced by taxation, the domestic production side distinguishes among agriculture, services, and four industrial sectors. The industrial sectors are consumer goods, capital goods, intermediate goods, and infrastructure. The classification in the input-output table defines the six domestic production sectors (see Appendix C of Devarajan and Sierra (1985)). Each sector supplies its own (homogeneous) commodity. Thus the model includes six domestically produced goods (this paper defines services as a good).

The paper opts for this small-scale disaggregation because that categorization seems sufficient to begin to explore some of the broad issues of indirect tax policy to be studied here. Moreover, to illustrate the general equilibrium methodology, a small-scale disaggregation is preferable because it makes the results easier to interpret. For the study of more specific tax policy questions, such as the effects of specific excises, however, a large-scale multisectoral model is called for.

[3] To compute the effects of large changes in policy, global nonlinear methods require global information on the various structural relations. The method applied in this paper requires only local information. Linear models, however, can account for nonlinearities by adopting a procedure of iterative linearization. See Bovenberg and Keller (1984).

[4] For a similar model of the Australian economy—the Orani model—the reference period has been estimated to be about one and a half to two years. See Cooper and McLaren (1983).

[5] Although the static model does not compute changes in stocks, the simulated changes in prices provide some information on the dynamic effects of taxation. For example, profitability in each production sector provides an indication of the effects on investment decisions in each sector and the interindustry allocation of capital (see Section II).

As regards the behavior of producers, this study adopts the usual assumption of perfect competition: firms take prices as given. They maximize profits subject to a production function, which may allow for substitution between the inputs. The inputs comprise imports, intermediate deliveries from other domestic producers, labor, and capital. Labor is further disaggregated into four categories: rural, unskilled urban, blue-collar, and white-collar. Capital is sector specific and immobile during the period of reference.

Transaction taxes are returned to households as lump-sum transfers. The transfer to the public household sector (or public sector) is the public budget. This paper assumes that the transfers to all private households are exogenously given in terms of the foreign good.[6] Thus a change in the revenue from transaction taxes accrues to the public household sector only. The public household sector demands goods and factors to satisfy public wants. The utility function of the public household sector endogenously determines public consumption.[7]

To simulate the consequences of tax policy for the equity objective, the private domestic household sector is classified into six categories. The rural household sector is disaggregated into two types of households: the own-account (or self-employed) rural household and the informal rural household. Both the own-account and informal households supply rural labor. In contrast to the own-account rural household, the informal rural household does not own any capital and does not save. The urban household sector consists of the own-account (or self-employed) urban, the informal urban, the blue-collar, and the white-collar households. The blue-collar and white-collar households are characterized by the type of labor they supply. The other two urban households supply unskilled urban labor.

Each household, including the public household sector, maximizes a regular, neoclassical utility function subject to a budget constraint. Private savings are treated as purchases of capital goods by households. Utility depends on demand for goods and the supply of factors. The after-tax prices and the lump-sum transfer determine the budget constraint. Households take prices and transfers as given.

The foreign household sector (or foreign sector) represents the rest of the world. Its budget constraint is the balance of payments constraint. The real exchange rate is free to reconcile Thailand's expenditures with its income and the exogenously given foreign savings.

[6] All foreign goods can be aggregated into a single foreign good because Thailand takes the prices of foreign goods as exogenously given.

[7] Under certain conditions (see Keller (1980)), this utility function can be derived from the preferences for public goods of private households.

Following Armington (1969), the model specifies product differentiation by country of origin: foreign goods are distinct from domestic goods. Final demands for imports enter the model as follows. Domestic final demand for each tradable good is a composite of imported final goods and domestically produced final goods. The composite good is called the Armington good and is produced by an Armington goods sector.[8] The value of the substitution elasticity between foreign and domestic inputs in this production (or aggregation) process can be varied between the extreme assumptions of infinity (perfect substitution) and zero (perfect complementarity).

Exports correspond to the demand of the foreign household. The assumption of product differentiation by country of origin yields less than infinitely elastic demand functions for a country's exports. Thus Thailand is not small in the markets for its exports and has some "monopoly power." If domestic and foreign goods are imperfect substitutes in the Armington aggregation, and if export demands are not infinitely elastic, the prices of domestic goods can move independently from the price of the foreign good, and the terms of trade are not fixed.

The model adopts the neoclassical closure rule; therefore it does not specify independent investment functions. Savings behavior determines domestic investment. This paper models savings as direct demand for a composite investment good, which is produced by a so-called investment sector. Thus, in addition to six domestic production sectors that supply domestic goods, the model includes seven composite goods sectors that supply composite goods: six Armington goods sectors and one investment sector. The input demands of the investment sector correspond to the investment demands for Armington goods.

Data Requirements

The basic data requirements for the model are as follows. First, the model needs a benchmark data set that describes for each household and firm sector the after-tax expenditures and receipts as well as transaction taxes paid on all goods and services. Second, the model requires information on the elasticities that describe the marginal behavior of the sectors.

The initial expenditures and receipts are derived from the data set for 1973 used in Devarajan and Sierra (1985). Both the data sources and the procedure adopted to arrive at a consistent data set are described in Appendix B of Devarajan and Sierra (1985). Tables 1–3 present the

[8] In the literature on general equilibrium modeling, an "Armington good" is defined as a composite of a domestic and a foreign good.

Table 1. *Expenditures and Receipts in Thailand, 1973: Domestic Production Sectors*
(In millions of baht)

Good	Sector						
	Agriculture	Consumption goods	Capital goods	Intermediate goods	Infra-structure	Services	Tax Rate[a]
Domestic goods							
Agriculture	−96,652.4	30,347.9	289.4	9,204.0	87.8	1,646.7	0.071
Consumption goods	2,183.8	−55,564.9	194.3	3,669.0	27.5	7,379.1	0.019
Capital goods	666.4	395.4	−51,392.4	1,677.4	1,485.4	3,109.5	0.056
Intermediate goods	7,345.7	4,699.5	13,631.3	−54,014.9	9,068.3	8,556.6	0.021
Infrastructure	154.4	2,493.8	991.9	4,317.9	−27,101.4	4,472.7	0.052
Services	1,476.9	724.4	1,090.6	2,797.6	994.3	−54,772.7	0.020
Primary factors							
Rural labor	50,629.4	—	—	—	—	1,113.5	—
Urban labor	—	3,621.3	8,529.0	2,675.4	2,939.2	5,508.3	—
Blue-collar labor	—	4,462.4	9,574.1	2,396.9	3,128.6	5,261.9	—
White-collar labor	—	109.0	251.6	1,204.8	140.6	2,888.2	—
Capital	32,633.2	5,492.2	9,792.6	9,637.8	6,143.5	12,786.5	—
Imports	1,562.6	3,218.9	7,047.6	16,434.1	3,086.2	2,049.3	—
Output/income	96,652.4	55,564.9	51,392.4	54,014.9	27,101.4	54,772.7	—

Source: Devarajan and Sierra (1985).
Note: Positive entries correspond to expenditures, negative entries to receipts.
[a] The tax rate corresponds to domestic tax revenue (revenue from business and excise taxes) per good relative to domestic expenditures (exclusive tax) on the good.

Table 2. *Expenditures and Receipts in Thailand, 1973: Composite Goods Sectors*

(In millions of baht)

Good	Sector						
	Investment	Agriculture (Armington)[a]	Consumption (Armington)[a]	Capital (Armington)[a]	Intermediate goods (Armington)[a]	Infra-structure (Armington)[a]	Services (Armington)[a]
Domestic goods							
Agriculture	—	57,030.7	—	—	—	—	—
Consumption goods	—	—	26,607.2	—	—	—	—
Capital goods	—	—	—	46,088.5	—	—	—
Intermediate goods	—	—	—	—	4,131.8	—	—
Infrastructure	—	—	—	—	—	16,184.5	—
Services	—	—	—	—	—	—	37,705.0
Composite goods[a]							
Investment good	−51,711.0	—	—	—	—	—	—
Agriculture (Armington)	1,312.8	−57,195.1	—	—	—	—	—
Consumption (Armington)	2,207.7	—	−28,452.4	—	—	—	—
Capital (Armington)	30,708.3	—	—	−57,840.5	—	—	—
Intermediate (Armington)	3,997.1	—	—	—	−8,219.8	—	—
Infrastructure (Armington)	8,722.9	—	—	—	—	−16,184.5	—
Services (Armington)	4,762.2	—	—	—	—	—	−39,294.7
Imports	—	164.4	1,845.2	11,752.0	4,088.0	—	1,589.7
Output/income	51,711.0	57,195.1	28,452.4	57,840.5	8,219.8	16,184.5	39,294.7

Source: Devarajan and Sierra (1985).

Note: Positive entries correspond to expenditures, negative entries to receipts.

[a] An "Armington" good (or goods sector) is a composite of a domestic and a foreign good (see Armington (1969)).

Table 3. *Expenditures and Receipts in Thailand, 1973: Household Sectors*
(In millions of baht)

	Sector							
Good	Public	Own-account rural	Own-account urban	Informal rural	Informal urban	Blue-collar	White-collar	Rest of world
Domestic goods								
Agriculture	—	—	—	—	—	—	—	5,741.3
Consumption goods	—	—	—	—	—	—	—	16,350.1
Capital goods	—	—	—	—	—	—	—	1,186.5
Intermediate goods	—	—	—	—	—	—	—	8,236.2
Infrastructure	—	—	—	—	—	—	—	—
Services	—	—	—	—	—	—	—	11,013.9
Composite goods[a]								
Investment good	6,967.0	23,076.4	10,074.6	—	2,902.2	5,121.0	2,996.8	573.0
Agriculture (Armington)	19.2	29,474.3	9,453.0	2,701.7	1,078.4	9,610.1	3,545.6	—

Consumption (Armington)	213.0	10,357.0	5,701.8	1,074.8	429.0	5,959.5	2,509.6	—
Capital (Armington)	352.1	11,575.4	5,581.7	961.9	384.0	5,023.4	3,253.7	—
Intermediate (Armington)	634.5	1,491.6	900.3	166.3	66.4	686.4	277.2	—
Infrastructure (Armington)	126.4	2,668.0	1,890.6	219.7	87.7	1,404.1	1,065.1	—
Services (Armington)	6,996.8	7,457.9	6,482.0	813.5	324.7	8,518.1	3,939.5	—
Primary factors								
Rural labor	—	−45,513.6	—	−5,932.5	—	—	—	—
Urban labor	—	—	−20,123.6	—	−2,405.2	—	—	—
Blue-collar labor	4,465.3	—	—	—	—	−30,663.9	—	1,919.3
White-collar labor	8,431.7	—	—	—	—	—	−12,743.4	479.7
Capital	—	−40,498.0	−19,901.0	—	−2,867.2	−5,574.3	−4,802.2	—
Imports	—	—	—	—	—	—	—	−46,069.0
Output/income	28,206.0	86,100.6	40,084.0	5,937.9	5,272.4	36,322.6	17,587.5	45,500.0

Source: Devarajan and Sierra (1985).
Note: Positive entries correspond to expenditures, negative entries to receipts.
[a] An "Armington" good (or goods sector) is a composite of a domestic and a foreign good (see Armington (1969)).

accounts. Each column in the tables corresponds to the after-tax expenditures by a particular sector. These accounts provide information on the structure of the Thai economy (in 1973). That structure is an important determinant of the tax effects. Therefore, it is useful to comment briefly on these accounts, starting with the accounts of the domestic production sectors.

The composition of the outputs over the domestic industries is characteristic of a semi-industrial country in which agriculture and services account for more than 40 percent of gross domestic production. Within the manufacturing sector, consumption goods, capital goods, and intermediate goods each provide about 15 percent of gross domestic production. The importance of various inputs varies considerably among domestic industries. Agriculture has by far the largest value-added share in total costs. Consumption goods and intermediate goods, in contrast, depend more on intermediate inputs.

The accounts also provide information on the trade orientation of the domestic production sectors. Within the traded-goods sector, industries can be grouped into three main categories: export-related, exportable (or export-oriented), and import-competing. Agriculture is export related because it sells a major part of its output to the consumption goods industry, which is the most export-oriented sector. Capital goods is an import-competing industry: The level of imported capital goods for final use, which combines with domestically produced goods in the Armington aggregation, indicates that the capital goods sector sells in a market with a high level of import penetration. The intermediate goods sector can be classified as import-dependent because of its large share of imported intermediate goods. Because of its moderate export share, this sector is also a tradable sector. The only "pure" nontradable sector is infrastructure, yet a large part of its intermediate inputs is imported. Because it includes trade-related services, the services sector has a moderately high export share.

The accounts reveal that the intermediate goods sector depends on intermediate demands from other domestic industries to sell its output. The capital goods sector and the service sector, however, depend primarily on final domestic demand.

The household accounts show that the rural households spend a relatively large proportion of their budget on the agricultural good. Services are an important expenditure item for the blue-collar and white-collar households. Savings rates show considerable variation among households and are related to the shares of capital income in total income. The contrast in savings behavior between the rural and urban informal sectors is particularly noticeable.

This section now turns to the basic features of the system of indirect taxation in Thailand, many of which are common to the systems of indirect taxation in other middle-income developing countries.[9] Several of these features—including substantial rate differentiation, cascading, and discrimination against international trade—are inconsistent with the policy objectives of efficiency, equity, and international competitiveness.

The business tax and excise taxes are modeled as ad valorem taxes. The tax rates differ among goods according to the observed tax revenue from each good. Table 1 indicates that the system of domestic indirect taxation is characterized by substantial rate differentiation, which creates a number of problems with regard to efficiency, equity, and competitiveness.

From the standpoint of efficiency, effective tax rates should systematically vary among goods in line with elasticities of demand and supply. Otherwise, economic decisions could well be more severely distorted than under a uniform rate structure. International competitiveness may also be hurt; when a large part of the nontradable services sector is exempt, production factors leave the tradable sectors. As regards the equity objective, differentiated tax rates are likely to be less effective in serving this objective than commonly presumed because the differentiated rates may be shifted backward.

Both the excise taxes and the business tax are basically cascade-type manufacturers' taxes and apply to both domestic intermediate demand and domestic final demand. Thus the tax rate "pyramids" when goods move through the channels of production. This process of cascading distorts intermediate demand and supply decisions. Moreover, the rate differentiation that results from cascading may distort final demand and supply decisions more than necessary and lead to uncertain—and often undesirable—distributional effects. Cascading also impedes exports because the tax component of input costs is typically not refunded when goods are exported.

As regards trade taxes, the export tax on agricultural products is an ad valorem tax on foreign demand for the agricultural product. Ad valorem taxes on demands for the foreign good by domestic industries and by the Armington sectors represent the import tariffs on intermediate and final imports, respectively. Trade taxes produce distortions in consumption and production decisions as well as inequities; they benefit sectors that produce import substitutes at the expense of sectors that depend on exports. In addition, trade taxes hurt the objective of export-led growth.

[9] For a more detailed discussion of the systems of indirect taxation in developing countries, see Gandhi (1979) and Tanzi (1983).

During the usual process of development, trade taxes gradually lose their significance for revenue and protection. Domestic economic activities take over as an important source of revenue. Domestic industries mature and are able to face international competition, thereby reducing the need for protection through trade taxation. At the same time, the development of strong export-oriented industries demands lower taxes on international trade.

Corporate taxes and income taxes are modeled as follows. Corporate taxes appear as taxes on capital employed in the production sectors, whereas income taxes appear as taxes on labor income received by households.

The discussion now turns to the specification of the elasticities that describe marginal behavior of the sectors.[10] For each household, income and price elasticities completely determine marginal behavior. For lack of information on the income elasticities, the simulations assume unitary income elasticities. Labor supply is fixed.

The following formula determines the price elasticities for each household:

$$\epsilon_{ij} = c_j n_i n_j \sigma_{ij} - c_j n_i \,. \tag{1}$$

Here ϵ_{ij} is the uncompensated price elasticity of good i with respect to the after-tax price of good j. The first term on the right-hand side stands for the compensated price elasticity, whereas the second term represents the income effect; c_j and n_j are the income share and the income elasticity of good j, respectively. The elasticities of substitution, σ_{ij}, are determined by nested constant elasticity of substitution (CES) utility functions. Nested utility functions allow for the modeling of differentiated substitution possibilities by defining various levels of aggregates and specifying distinct elasticities of substitution between those aggregates.[11]

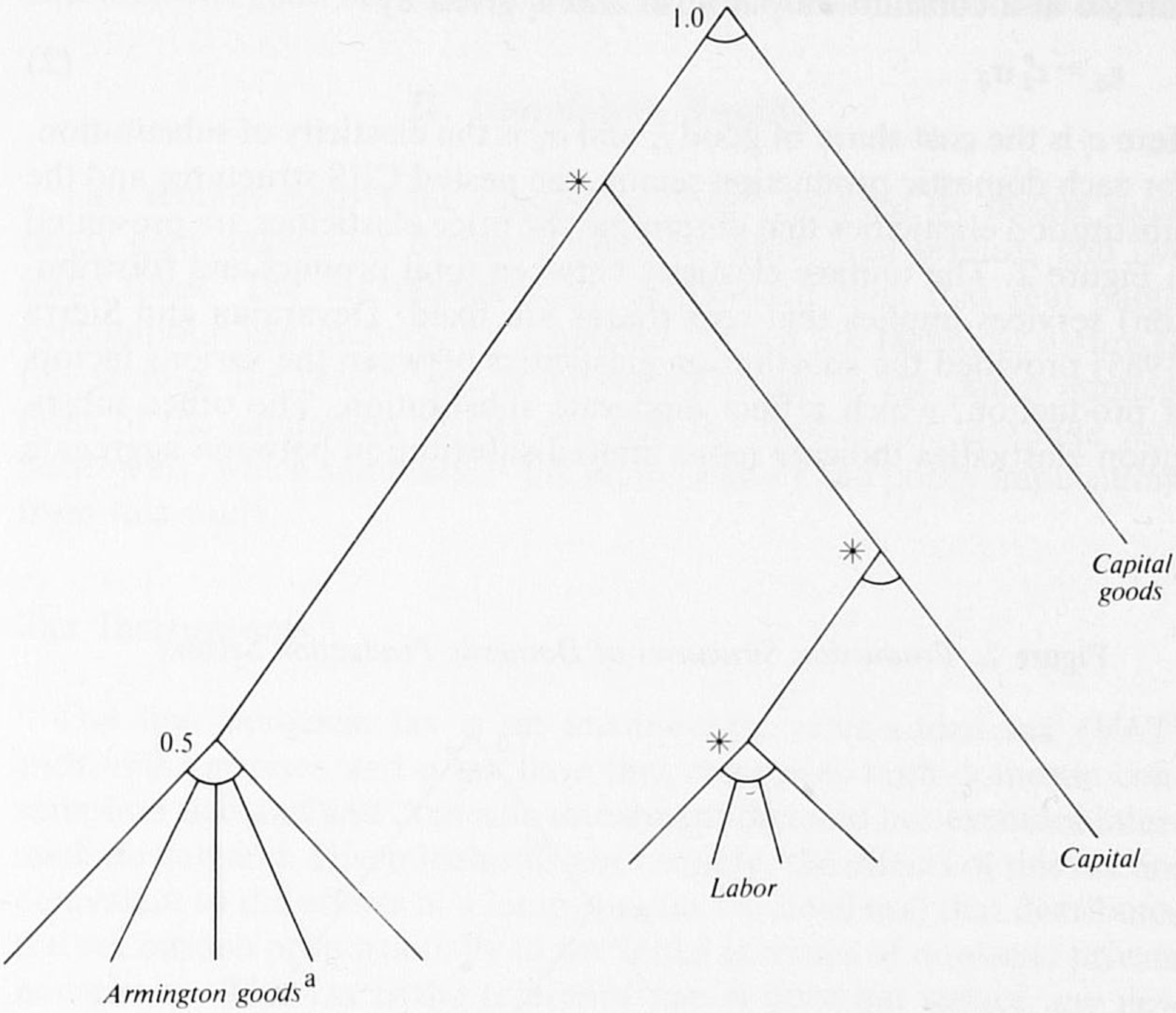
Figure 1 reports the nested utility structures along with the elasticities of substitution adopted for the domestic private households. The unitary elasticity between total consumption and capital goods (that is, savings) implies a fixed propensity to save independent of the rate of return.[12] Most studies on consumer demand systems find moderate substitution

[10] The elasticities refer to the reference period, which is about three years. See above, under "A Particular General Equilibrium Model."

[11] See Keller (1980) for a derivation of equation (1) as well as for more detailed discussion on nested CES utility functions.

[12] Empirical studies on savings behavior in developing countries have not resolved whether an increase in interest rates will raise the savings rate. See, for example, Ebrill (1984).

Figure 1. *Utility Structures of Domestic Household Sectors*



* Given inelastic factor supply, these elasticities are not relevant.
[a] An "Armington" good is a composite of a domestic good and a foreign good; see Armington (1969) and the discussion in the text.

between consumption goods; the (partial) elasticity of substitution of 0.5 between consumer goods reflects this finding. Public demand is price inelastic, which is represented by a substitution elasticity of zero.

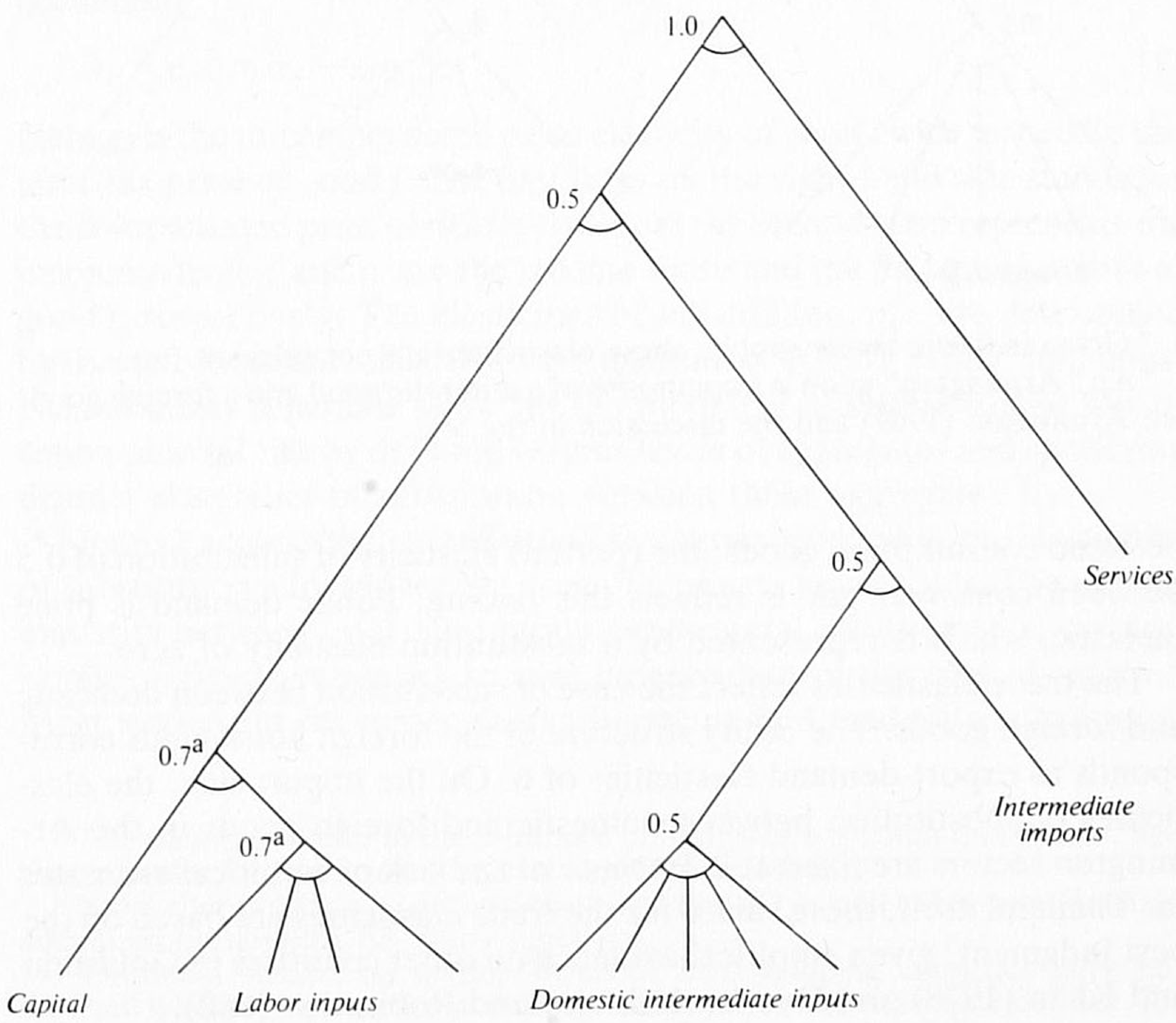
The trade elasticities reflect the ease of substitution between domestic and foreign goods. The utility structure of the foreign households corresponds to export-demand elasticities of 6. On the import side, the elasticities of substitution between domestic and foreign goods in the Armington sectors are fixed at 2. Because of the lack of empirical estimates for Thailand itself, these values for the trade elasticities are based on the best judgment, given empirical evidence on other countries in Goldstein and Khan (1978) and Dervis, de Melo, and Robinson (1982).

For each production sector, price elasticities describe marginal behavior. The price elasticity of good i with respect to after-tax price j, ϵ_{ij}, is defined at a constant output level and is given by

$$\epsilon_{ij} = c_j \, \sigma_{ij} \,. \tag{2}$$

Here c_j is the cost share of good j, and σ_{ij} is the elasticity of substitution. For each domestic production sector, the nested CES structures and the substitution elasticities that determine the price elasticities are presented in Figure 2. The unitary elasticity between total product and (distribution) services implies that cost shares are fixed. Devarajan and Sierra (1985) provided the substitution elasticities between the various factors of production, which reflect moderate substitution. The other substitution elasticities indicate more limited substitution between aggregate

Figure 2. *Production Structures of Domestic Production Sectors*



[a] For the agricultural sector, these elasticities are 0.9.

intermediate input and value added, between domestic and imported intermediates, and between domestically produced intermediate inputs.

II. Simulation Results

This section reports the simulation results induced by raising separately eight taxes—six domestic taxes on goods and services and two trade taxes. The tax measures are normalized such that real public consumption can increase by 1 percent. Given the technical nature of this section, the reader who is interested mainly in the policy implications of the simulation results can skip the section and continue with Section III, which summarizes the major lessons and policy implications from this study.

Tax Instruments

The first domestic tax is an income-type value-added tax (VAT) with uniform rates and a tax base that comprises both domestic consumption demand and domestic investment demand but excludes intermediate demand. Given inelastic labor supply, the effects of this tax are equivalent to the effects of a lump-sum tax (or head tax) that distributes the tax burden proportionally to the initial incomes of domestic private households. This tax is the reference tax; it does not induce any new incentive effects or distortions in view of the assumed inelastic labor supply. Comparing the effects of tax instruments with those of the reference tax isolates the incentive and distributional effects of these tax instruments.

The other four types of VAT that are simulated are consumption based; they apply zero rates to investment demand and intermediate demand. The first is an ideal-consumption VAT (or expenditure tax), which applies the same tax rate to all consumption goods. The section then examines a differentiated rate structure for consumption goods, as well as the difference between a zero rate and an exemption, by simulating the effects of both zero-rating and exempting agriculture. There is an important difference between zero-rating and exemption. In contrast to an exempt sector, which pays tax on its intermediate inputs, a zero-rated sector receives a tax rebate for the VAT on its intermediate inputs. The fourth VAT exempts the service sector, which for administrative reasons is difficult to tax. The last domestic tax is the existing tax on domestic transactions. The simulated trade taxes are a uniform import tariff and an export tax on the agricultural good.

The Tables

Tables 4, 5, and 6 contain the simulation results for the eight tax instruments. The simulation results in the tables use the initial equilibrium (before any tax changes) as the benchmark; the changes contained in the tables are measured with respect to the initial equilibrium. Except for the discussion of the income-based VAT in the next subsection, the discussions of the tax instruments will use an equilibrium after an alternative tax instrument has been raised to increase real public consumption by 1 percent as the benchmark. Such a comparison isolates the differential incentive and distributional effects of taxes and amounts to comparing two columns in the tables.

Table 4 contains the results for revenue and relative prices. The first part ("Change in tax wedge") indicates the revenue effects by presenting the change in the tax instrument that is required to raise public consumption by 1 percent. For all tax instruments except the existing tax on domestic transactions, the change in the tax instrument is defined as the change in the tax wedge (the difference between the before-tax price and the after-tax price) as a percentage of the after-tax price. Because the existing tax on domestic transactions is characterized by a multiplicity of rates, the absolute change in the wedge depends on the size of the initial tax rate. Therefore, the change in this tax instrument is defined as the change in the tax wedge as a percentage of the initial tax wedge. The second part of the table contains the effects on the relative after-tax supply prices of domestic goods, which the domestic industries receive. The consequences for the demand prices of the investment good and the Armington goods, which the domestic households pay, are presented in the third part. Relative changes in these demand prices indicate that taxes are shifted forward. The last part of the table contains the effects on wages and average capital earnings. Given the equality between costs—including profits—and revenues, factor prices of production factors employed in a particular industry tend to be positively related to after-tax supply prices of the good produced in that industry and negatively related to the demand prices of intermediate inputs. Relative changes in these factor prices indicate that taxes are shifted backward. All price changes are measured with respect to the fixed world price of foreign goods.

The first part of Table 5 ("Relative change in capital earnings") reports the effects on the production structure. It presents the relative changes in the capital earnings (or profitability) in each domestic production sector, which provide an indication for the effect of tax policy on the interindustry allocation of capital; over time, capital moves toward those sectors in which the capital rental rises relative to average capital earnings. The second part of the table contains the consequences for exports of each industry, and the last part shows the same for total imports.

Table 6 presents the welfare (or income) effects. These effects are measured by the relative change in income that is equivalent to the change in utility induced by the change in tax policy. The income effect for private households does not include the welfare effects from the 1 percent change in public consumption. This effect, however, is reflected in the income effect for the public household. The sum of the income effects corresponding to all domestic households is defined as the national income effect. The aggregate income effect is computed as the sum of all the income effects—including that of the foreign household. This aggregate measure—the negative "excess burden"—reflects the efficiency effects of a tax change; a positive efficiency effect (or negative excess burden) indicates that a Pareto improvement might be realized so that the gainers could compensate the losers.

The array of income effects across households reflects distributional consequences. By assigning "social" weights to these distributional effects, one can compute social welfare. The national income effect assigns a zero weight to the foreign household, whereas the aggregate income effect attaches a uniform weight to all households. Therefore, this latter measure reflects the consequences for world efficiency. It is expressed both as a percentage of national income and as a percentage of the increase in public consumption. This latter percentage corresponds to the "welfare" cost of different tax instruments per unit of additional real tax revenue raised.

To interpret the aggregate efficiency effect, equation (3) expresses the aggregate income effect relative to national income I with respect to its origin:

$$I = \sum_i t^i q^i. \tag{3}$$

Here t^i is the vector of shares of transaction taxes paid by (household or firm) sector i in national income and reflects the existing distortions in the economy. The symbol q^i stands for the vector of relative changes in real demand or supply by sector i. The formula shows that the efficiency effect is positive (negative) when the volume of taxed transactions increases (decreases) or when resources are reallocated toward a more (less) heavily taxed sector. The intuition is that because the marginal benefit of taxed items exceeds the marginal costs, larger transactions raise real income. In the presence of several existing distortions, the magnitude and sign of the aggregate efficiency effect is determined in a

Table 4. *Effects on Revenue and Relative Prices*
(In percent × 100)

Change in Tax or Price	Value-Added Tax (VAT) Income-based	Consumption-based	Agriculture zero rate	Agriculture exempt	Services exempt	Existing Domestic Tax Structure	Uniform Import Tariff	Export Tax on Agriculture
1. Change in tax wedge[a]	27.0	35.3	55.9	49.0	35.8	3,912.0[b]	110.8	10,241.0
2. Relative change in producer prices for domestic goods								
Agriculture	−12.6	−17.4	−8.9	−5.9	−19.8	−23.7	−3.7	−3,442.0
Consumption goods	−3.9	−5.6	−3.7	−2.8	−8.4	1.1	11.5	−1,536.8
Capital goods	4.3	7.9	4.6	3.1	3.5	4.5	41.4	−255.0
Intermediate goods	4.3	4.7	4.2	3.5	2.1	9.6	39.9	−609.9
Infrastructure	4.5	7.9	4.0	2.8	2.8	4.8	34.5	−242.5
Services	15.2	15.6	12.6	12.0	27.0	16.8	31.7	−363.9

3. Relative change in final demand prices for composite goods								
Investment good	30.8	6.0	3.5	2.9	3.7	18.8	48.5	−365.9
Agriculture	14.4	18.0	−8.9	−5.9	16.1	−2.6	−3.4	−3,432.1
Consumption goods	23.4	30.1	52.4	46.4	27.9	7.1	17.9	−1,437.2
Capital goods	30.4	41.6	59.1	51.5	38.5	20.5	55.5	−203.2
Intermediate goods	29.2	37.7	58.0	50.8	36.8	11.4	75.1	−306.6
Infrastructure	31.5	43.2	59.9	51.8	38.5	20.6	34.5	−242.5
Services	41.6	50.2	68.0	60.6	25.9	22.3	34.9	−349.1
4. Relative change in primary factor prices								
Average capital rental	−8.8	−9.2	−8.8	−11.8	−15.0	−24.6	−7.6	−1,462.8
Rural labor	−15.1	−20.7	−10.9	−15.2	−23.4	−31.5	−11.1	−3,864.9
Unskilled urban labor	−4.4	0.1	−6.9	−8.7	−7.4	−18.4	4.0	296.4
Blue-collar labor	21.3	26.0	18.8	17.0	18.8	7.3	30.7	377.9
White-collar labor	259.5	259.5	254.0	253.0	249.5	246.2	249.2	568.3

Source: Author's simulations.
[a] Relative to the initial after-tax price for a 1 percent increase in public consumption.
[b] Defined as the change in the tax wedge relative to its initial level.

Table 5. *Effects on Production Structure*

(In percent × 100)

Change in Price or Volume	VAT					Existing Domestic Tax Structure	Uniform Import Tariff	Export Tax on Agriculture
	Income-based	Consumption-based	Agriculture zero rate	Agriculture exempt	Services exempt			
1. Relative change in capital earnings in domestic production sector								
Average rental	−8.8	−9.2	−8.8	−11.8	−15.0	−24.6	−7.6	−1,462.8
Agriculture	−15.4	−21.0	−10.9	−15.3	−23.5	−31.9	−11.2	−3,935.3
Consumption goods	2.5	3.2	−11.1	−14.5	2.0	−15.6	−18.0	3,655.8
Capital goods	−9.0	0.6	−4.9	−5.7	−5.6	−20.6	35.0	−934.5
Intermediate goods	−6.3	−3.2	−6.9	−12.6	−9.7	−32.6	−38.1	465.4
Infrastructure	−4.4	4.5	−3.7	−5.5	−7.5	−21.4	−0.5	−340.3
Services	−0.8	−3.4	−9.1	−9.1	−15.3	−8.5	−6.8	251.5

2. Change in exports relative to final demand in domestic production sector[a]								
Agriculture	3.9	5.4	2.8	1.8	6.1	7.3	1.2	−2,102.8
Consumption goods	6.9	9.8	6.5	4.9	14.8	−1.9	−19.9	2,711.7
Capital goods	−0.6	−1.1	−0.6	−0.4	−0.5	−0.6	−5.7	35.4
Intermediate goods	−3.8	−4.3	−3.8	−3.1	−1.9	−8.6	−35.9	552.2
Services	−18.2	−18.7	−15.2	−14.5	−32.4	−20.2	−37.9	439.0
3. Change in imports relative to initial level								
Imports	−3.7	0.7	−3.7	−5.9	−3.8	−13.1	−90.2	−477.3

Source: Author's simulations.
[a] The infrastructure sector does not export and thus is omitted.

Table 6. *Welfare Effects*
(In percent × 100)

Change in Income	VAT					Existing Domestic Tax Structure	Uniform Import Tariff	Export Tax on Agriculture
	Income-based	Consumption-based	Agriculture zero rate	Agriculture exempt	Services exempt			
1. Change in real income relative to initial level								
Public	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Own-account rural	−37.3	−38.8	−31.0	−32.7	−38.7	−38.8	−36.0	−1,215.8
Own-account urban	−34.2	−31.2	−37.2	−36.5	−31.9	−34.5	−32.7	610.6
Informal rural	−38.5	−50.6	−39.1	−40.9	−47.9	−39.1	−29.9	−1,941.3
Informal urban	−34.3	−21.6	−22.4	−23.4	−24.6	−35.7	−37.7	386.6
Blue-collar	−11.2	−9.9	−19.8	−18.2	−9.4	−10.0	−2.6	1,406.7
White-collar	155.6	153.4	143.7	145.7	151.9	156.5	146.0	1,093.8
Rest of the world	−5.6	−4.5	−5.0	−5.3	−4.9	−6.5	−25.5	−117.7

2. Change in real national income relative to initial level[a]	0.838	0.840	0.650	0.431	0.712	0.446	2.422	−68.649
3. Change in real aggregate income relative to initial national income[b]	−0.318	−0.102	−0.382	−0.667	−0.313	−0.891	−2.868	−93.051
4. Change in real aggregate income relative to change in public consumption	−252.0	−84.0	−297.0	−516.0	−251.0	−698.0	−2,239.0	−72,703.0

Source: Author's simulations.
[a] National income includes income of the public sector but excludes income of the foreign sector.
[b] Aggregate income comprises the incomes of all household sectors, including the public sector and the foreign sector.

complicated way and often is not intuitively predictable. The methodology presented in this paper allows for the explicit examination of the complex interaction between existing distortions and tax policy.

Equation (3) not only illustrates the interaction among tax distortions in a second-best world, but it also provides a link with the revenue effects. The elements in the expression for the efficiency effect correspond to the changes in tax revenue that are induced by the changes in the tax base. Thus the efficiency effect reflects the change in tax revenue beyond the change in revenue under the assumption of unchanged tax bases.

Income-Based VAT

This subsection discusses the changes in the initial equilibrium that are induced by the reference tax, an income-based VAT (see the first columns of Tables 4–6). The changes in the initial equilibrium are heavily influenced by the composition of public expenditure because the tax increase involves a transfer of purchasing power to the public sector.

An examination of the supply prices of domestic goods (Table 4, second part) shows that the producer prices of agricultural and consumption goods decline, whereas the supply price of services increases the most. The declining price for agricultural goods is explained by the transfer of purchasing power from the private households, which demand most of the agricultural good, to the public household, which demands almost none of the agricultural good (see Tables 1–3). The producer price of the consumption goods sector falls because intermediate purchases of the cheaper agricultural product account for more than half of the input costs in this sector. The costs of the service sector, in contrast, rise because increased public demand for white-collar labor raises white-collar wages. This cost effect, combined with rising aggregate demand for services because of relatively large public purchases, causes the producer price of services to increase.

The relative profitability of capital in each sector (Table 5, first part) indicates the relevance of the interindustry demand structure for intermediate goods. Although the public household demands very few consumption goods, the consumption goods sector benefits most from the expansion of public demand because of the declining costs of agricultural intermediate inputs.

The exports by sector (Table 5, second part) reflect the changes in producer prices, which apart from the export tax on the agricultural good are the prices that foreigners face. The sectors with declining supply prices—agriculture and consumption goods—increase their exports. The exports in the other sectors decline. Domestic demand pressure and rising costs hit exported services particularly hard. Imports decline because public demand is not import intensive.

World efficiency, which is represented by the aggregate income effect (Table 6, third and last parts), tends to be positively related to the volume of imports because imports are relatively heavily taxed (see equation (3)). Thus, declining imports reduce efficiency. This efficiency effect illustrates that, although a lump-sum tax has no consequences for efficiency in an undistorted economy, it certainly does have consequences for efficiency in a distorted economy.

Broadly Based Consumption VAT

This subsection compares a consumption-based VAT, which "zero-rates" investment goods, with an income-based VAT, discussed in the previous subsection. The discussion in this subsection measures all effects of the consumption-based VAT with respect to the effects of the income-based VAT (in other words, the difference between the second and first columns of Tables 4–6). In doing so, the discussion focuses on the differential incentive and distributional effects of the consumption-based and income-based VATs. By comparing two taxes that yield the same change in real public expenditure, the discussion is not affected by the composition of public expenditure.

Zero-rating the investment good increases the producer prices of the industries that supply investment goods (capital goods and infrastructure) or that supply intermediate goods to these industries (intermediate goods) (Table 4, second part). The producer price of the agricultural good, in contrast, decreases because domestic demand shifts away from the agricultural good toward the investment good.

Not only these relative producer prices, but also the factor prices, indicate that the zero rate is partially shifted backward (Table 4, last part; and Table 5, first part). The production factors that are mainly employed in the sectors that depend on investment demand—unskilled urban and blue-collar labor and capital employed in the capital goods and infrastructure sectors—gain. Rural labor and agricultural capital, however, lose. Capital employed in the consumption goods sector gains because of the reduced cost of intermediate agricultural inputs.

The backward shifting can be quantified by subtracting the first column from the second column in Tables 4 and 5. Introducing a 1 percent consumption VAT, instead of an income-based VAT to raise public consumption, increases the producer price of capital goods relative to agricultural goods by about 0.23 percent (Table 4, second part) and capital earnings of the capital goods sector relative to the agricultural sector by about 0.43 percent (Table 5, first part).

Zero-rating investment stimulates both imports and exports (Table 5, second and last parts). Imports increase because the investment good consists primarily of import substitutes and goods produced by import-dependent sectors. Exports increase because investment requires relatively few exportables and goods produced by export-dependent sectors. Consequently, zero-rating investment reduces domestic demand for these goods, thereby reducing the prices that foreigners face.

World efficiency benefits from increased international trade because both the exports of agricultural products and imports are taxed heavily. The efficiency effect, however, is rather small—about 1.7 percent of additional real tax revenue (Table 6, last part). Although the foreign sector benefits from the increases in export supply and import demand, real national income is practically unaffected.

Domestic distributional effects indicate that both forward and backward shifting is relevant (Table 6, first part). Households that have relatively high savings rates and supply labor that is employed in investment goods industries—the urban sectors—gain. The informal rural sector, which does not save and depends on agricultural labor, suffers more severely than the own-account rural sector, which benefits from its relatively high savings rate but suffers from the declining earnings in the agricultural sector. Relative to the efficiency effects, the equity effects are substantial. To illustrate, substituting a consumption-based VAT for an income-based VAT to finance 1 percent of public consumption decreases real income of the informal rural sector by 0.12 percent while raising real income of the informal urban sector by the same percentage.

A Zero Rate for Agriculture

This subsection analyzes the consequences of narrowing the tax base of the consumption-based VAT by zero-rating the agricultural good. It compares the effects of this narrowly based VAT with the broadly based consumption VAT, which was discussed in the previous subsection. This comparison amounts to the difference between the third and second columns of Tables 4–6. Zero-rating the agricultural good is often advocated for distributional reasons.

The increases in the relative producer price of the agricultural good, the rural wage, and the profitability of the agricultural sector indicate that the zero rate is partially shifted backward. The producer prices of the nonagricultural domestic goods decrease except for the supply price of the consumer good, which increases because of the higher cost of the agricultural intermediate input (Table 4, second part).

Capital and labor employed in the nonagricultural sectors suffer from the shift of domestic demand to the agricultural good (Table 4, last part;

and Table 5, first part). The differential rate structure hits the consumption goods sector particularly hard. This sector not only suffers from decreased domestic demand but also from increased input costs because of the higher price of agricultural inputs.

The effect of the zero rate for the agricultural good on international transactions and world efficiency is just the reverse of the effects of the zero rate for the investment good. International trade declines because the zero-rated good is now produced by an export-related sector and not by import-competing or import-dependent sectors (Table 5, second and last parts).

Increased domestic final demand for the agricultural good crowds out direct foreign demand as well as intermediate demand from the exportable consumption goods sector. Imports decline because domestic demand shifts away from import-intensive goods. World efficiency suffers not only from the reduction in heavily taxed imports but also from the shift in the composition of exports away from the heavily taxed agricultural exports. Both the foreign sector and the domestic economy share in the worldwide welfare loss, which is a little over 2 percent of additional real tax revenue (Table 6, third and last parts).

The domestic distributional effects differ from the equity effects of zero-rating the investment good also (Table 6, first part). Rural households gain while the urban sectors lose. Because the relative expenditure shares on the agricultural good vary less between households than savings shares do, backward shifting becomes even more important. Own-account and informal rural households gain 0.08 percent and 0.11 percent of their real incomes, respectively, while all other households lose. The real income losses of all the other households vary between 0.01 percent (informal urban household) to almost 0.10 percent (blue- and white-collar households).

The following conclusions emerge on the effects of a differential rate structure for domestic consumption taxation on equity, industrial structure, international trade, and efficiency.

- Differential rates are partially shifted backward, particularly when supply is inelastic, intermediate and foreign demands are inelastic, final domestic demand is elastic, and the good with a differential rate is nontradable and primarily demanded by domestic consumers. Moreover, backward shifting is more powerful than forward shifting in affecting the income distribution because the composition of earnings varies more among households than does the composition of consumption. Thus, differential rates can be more effective in altering the distribution from the source side than from the user's side.
- Lower rates for a particular good benefit the sector producing that

good when the tax is shifted backward (see above). The other industries suffer. Tradable industries suffer from the cost side when they depend on a low-rate nontradable good that is inelastically supplied for their intermediate inputs. Nontradable industries suffer from the demand side when their output is highly substitutable by the lower-rate good while dependent on final domestic consumption demand. The more tradable and the more elastically supplied the low-rated good is, the more the nontradable sector suffers.

• Lower rates on domestic demand for exportables or goods produced by export-dependent sectors act as implicit export taxes by crowding out foreign demand. Lower rates on domestic demand for import substitutes or goods produced by import-dependent sectors act as import subsidies and benefit international trade.

• In countries with significant trade taxation, the interaction of the rate structure of domestic consumption taxes with the distortions induced by trade taxes is more important for the efficiency objective than the distortions introduced by the differential structure itself. A differential rate structure that enhances international trade—with, for example, relatively high rates on domestic demand for nontradables and exportables—can benefit the efficiency objective.

Exempting Agriculture

This subsection compares exempting the agricultural good with zero-rating that good. All the effects of the exemption for agriculture are discussed here with respect to the effects of the zero rate for this sector. This comparison amounts to the difference between the fourth and third columns of Tables 4–6. The producer prices of the domestic goods, except for the agricultural good and the consumer good, decrease relative to world prices (Table 4, second part). The real exchange rate—domestic producer prices in terms of the foreign good—falls because exempting the agricultural sector hurts exports, for reasons discussed below.

The relative supply price of the agricultural good increases because of the rising after-tax costs of intermediate inputs, which are taxed. The rising price of the agricultural good raises the input costs for the consumer goods sector, thereby increasing the supply price of consumer goods.

Exempting instead of zero-rating the agricultural sector hurts the agricultural and the consumption goods sectors because of the rising cost of intermediate inputs for these sectors (Table 5, first part). The intermediate goods industry, which is import dependent, suffers from the larger cost of both agricultural and foreign intermediate inputs. The import-competing capital goods sector benefits from the declining real exchange rate.

International trade suffers from the exemption (Table 5, second and last parts). Exports decline because the tax component of intermediate inputs in the exportable or export-related industries—agriculture and consumption goods—is not rebated. Imports decline because the real exchange rate drops.

The decline in taxed imports and agricultural exports hurts welfare—both domestically and worldwide (Table 6). Exempting agriculture instead of zero-rating it hurts total and domestic real income by 2.2 percent and 1.7 percent of additional real tax revenue, respectively.

Exempting Services

This subsection continues to analyze the effects of exemptions. It compares the effects of a consumption-based VAT that exempts the services sector with the broadly based consumption VAT, a tax discussed earlier. This comparison amounts to the difference between the fifth and the second columns of Tables 4–6.

The consequences for the relative commodity prices are the following (Table 4, second and third parts). The producer prices and the demand prices of the nonexempt goods decrease because of a falling real exchange rate. The producer price of services increases because of rising after-tax costs. Because (in contrast to the broadly based VAT) no taxes are levied on the producer price of services, the demand price of services drops.

In contrast to the exemption of agriculture, the exemption of services negatively affects the profitability of the exempted sector (Table 5, first part). The services sector suffers from its exemption for two reasons. First, the production costs in an exempted sector rise because the VAT on its intermediate inputs can no longer be rebated. Because the share of intermediate input costs in total production costs is large in the service sector, its costs increase substantially. Second, elastic foreign and domestic intermediate demands shift these increased costs backward to the services sector. Thus the services sector benefits when it is included in the VAT net, which illustrates the self-enforcing character of a VAT that is based on the credit system.

The exemption affects the nonexempted industries as follows. The declining real exchange rate hurts the import-dependent sectors while it benefits the tradable sectors. The exportable and export-dependent sectors gain relative to the import-competing sectors because, in Thailand, they are less dependent on imports for their intermediate inputs.

In analogy to the exemption of the agricultural good, the exemption of services hurts exports, imports, and efficiency (Table 5, second and last parts; and Table 6, third and last parts). But efficiency suffers less from exempting services than it does from exempting agriculture. Exempting services instead of agriculture raises aggregate real income by 2.7 percent of additional real tax revenue. (Compare the fourth and fifth columns in Table 6, last part.) This is a surprising result when only domestic demand distortions are considered because domestic taxes impose higher tax rates on agricultural commodities than on services (see Table 1). Thus, reducing the tax on the agricultural good makes the rate structure more uniform and—with equal demand elasticities—reduces domestic demand distortions. The general equilibrium framework, however, incorporates the distortions induced by trade taxes. It reveals that exempting agriculture aggravates these distortions more severely than does exempting services, since exempting agriculture hits heavily taxed imports and agricultural exports more severely. The resultant efficiency loss from exempting agriculture more than offsets the efficiency gain from reduced domestic demand distortions.

The following conclusions emerge on the consequences of exempting a production sector from consumption taxation for reasons of efficiency and industrial structure.

- From the standpoint of efficiency, trade distortions strengthen the case against exemptions and in favor of a broad tax base. Taxing intermediate inputs in an exempted sector implies an implicit tax on domestic producton that—in contrast to a domestic consumption tax—not only hits domestic demand but also foreign demand. Therefore, taxing intermediate transactions through an exemption not only reduces domestic production efficiency but also aggravates trade distortions.
- The exempted sector suffers from the exemption if it (1) has a low value-added share in gross production, (2) is a tradable sector, (3) depends on elastic intermediate demand (share of final demand in output is low), or (4) faces inelastic domestic consumption demand.
- The nonexempt tradable sectors suffer if an exempted nontradable good is an important element in their input costs. They benefit, however, when the exemption of a tradable sector decreases the real exchange rate. The nonexempt nontradable sectors that are import dependent suffer when the exemption increases the relative cost of the foreign good.

Existing Domestic Taxes on Goods and Services

This subsection analyzes the effects of raising the rates of existing domestic taxation on goods and services—the business tax and excise taxes. The effects are measured with respect to the effects of the income-based VAT.[13] This comparison amounts to the difference between the sixth and first columns of Tables 4–6.

The relative earnings of the production factors (the relative profitability of sectoral capital and the real wages) indicate backward shifting of both the increased costs of intermediary inputs and the differential tax rates on output[14] (Table 4, last part; and Table 5, first part). The intermediate and consumer goods sectors, as well as agriculture, suffer from existing domestic taxation, whereas the capital goods and service sectors gain.

Export-oriented sectors with high intermediate cost shares (consumer and intermediate goods) suffer from cascading. These sectors cannot shift the rising cost of intermediate inputs forward because they face elastic foreign demand. Thus, by decreasing the profitability of capital in the export sectors with low value-added shares, cascading impedes the development of a competitive export sector. It also imposes an arbitrary burden on the production factors that are employed in these sectors.

International trade suffers from taxing intermediate transactions (Table 5, second and last parts). Exports in all sectors except agriculture decline because, analogous to an exemption, taxing intermediate transactions raises the cost of domestic production. Because the export-oriented sectors (consumer goods and intermediate goods) have high intermediate cost shares, taxing intermediate transactions hurts exports particularly severely. Agricultural exports increase because both domestic intermediate demand from exportable industries and domestic final demand decrease because of the high tax rate on domestic demand. Thus cascading does not necessarily hurt exports in each industry. In particular, export-related industries with inelastic supply may increase their direct exports when taxes on domestic intermediate transactions decrease intermediate demand from export industries. As regards imports, import demand for intermediate goods declines because of the tax on intermediate transactions. In addition, import demand suffers from the declining real exchange rate.

World efficiency decreases by about 3.5 percent of additional public utility (Table 6, third and last parts). About 65 percent of this decline is attributable to a fall in imports, which hurts the efficiency of international trade. The other 35 percent is almost entirely accounted for by

[13] These relative effects can be interpreted as the reverse effects of a tax package that reduces cascading and rate differentiation. This tax package consists of a cut in the excise and business tax rates, compensated for by the introduction of an income-based VAT such that public consumption is unaffected.

[14] Table 1 contains these differential tax rates.

Table 7. *Welfare Effects and Export Elasticities*

(As percentage of real change in public consumption)

	VAT					Existing Domestic Tax Structure	Uniform Import Tariff	Export Tax on Agriculture
Welfare Gain	Income-based	Consumption-based	Agriculture zero rate	Agriculture exempt	Services exempt			
			Base case (export demand elasticities = 6.0)					
National	6.55	6.56	5.08	3.37	5.56	3.48	18.92	−536.32
Aggregate	−2.48	−0.80	−2.98	−5.21	−2.45	−6.96	−22.41	−726.96
			Protectionist case (export demand elasticities = 2.0)					
National	11.72	7.03	10.16	10.16	10.16	14.06	94.53	65.63
Aggregate	−2.34	−1.56	−3.13	−4.96	−3.13	−7.03	−13.28	−56.25
			Nonprotectionist case (export demand elasticities = 20.0)					
National	4.69	6.25	3.13	0.78	3.91	—	−7.81	145.31[a]
Aggregate	−2.34	—	−3.13	−5.47	−1.56	−5.47	−25.00	157.81

Source: Author's simulations.

[a] In the nonprotectionist case, the export tax on agriculture decreases tax revenue. Thus the export tax must decrease to raise public consumption by 1 percent.

declining efficiency in domestic production. Domestic production efficiency suffers because the tax on intermediate inputs reduces intermediate transactions for which marginal benefits exceed marginal costs.

Import Tariff

This subsection compares the effects of a uniform import tariff with the effects of the income-based VAT, the reference tax. This comparison amounts to the difference between the seventh and first columns of Tables 4–6.

The effects on the relative producer prices, capital earnings, and wages are as follows (Table 4, second and last parts; and Table 5, first part). The producer prices of import substitutes (capital goods) and goods produced by import-dependent industries (intermediate goods, infrastructure) rise relative to the producer prices of exportables (consumer goods). The profitability of the exportables (consumer goods) suffers from the rising real exchange rate, whereas the capital earnings in the import-dependent industries suffer from the rising costs of the foreign good. The profitability in the intermediate goods industry declines most markedly because it is import dependent and also produces an exportable good. The relative capital earnings in this sector decline by 0.3 percent for a 1.0 percent increase in the import tariff. The industry producing import substitutes (capital goods) benefits from the protection that is provided by the tariff. Its relative profitability increases by almost 0.4 percent for a 1.0 percent increase in the tariff.

The decline in international trade severely hurts world efficiency (Table 6, third and last parts). The incremental welfare cost amounts to about 22 percent of additional tax revenue. This relatively large loss in efficiency reflects the revenue losses that result from the erosion of the tax base. There is, however, a trade-off between national and world welfare because the national economy can shift the welfare cost to the foreign household. Table 7, which contains the welfare effects when the export elasticities are 20.0, indicates that if the export elasticities are larger the national economy shares in the worldwide welfare loss.

Export Tax on Agricultural Products

The discussion of the export tax on agricultural products will be brief. The changes that the export tax induces are large because the tax rate needs to be raised substantially in order to raise real public consumption by 1 percent. This is due not only to the relatively small tax base but also to the shape of the general equilibrium, export tax Laffer curve, which has only a small positive slope at the initial export tax of 15 percent. Because the export tax lowers the real exchange rate, it erodes not only the base of the export tax but also the base of the import tariffs. Table 7 shows that when the trade elasticities are larger, Thailand is on the downward-sloping part of the Laffer curve for the export tax.

The export tax is inefficient. It not only imposes an incremental worldwide welfare cost of more than 700 percent of additional public consumption, but it also decreases national welfare by more than 500 percent of tax revenue. This decline in national welfare indicates the importance of second-best considerations: the initial export tax is below the optimal export duty of 17 percent derived from the inverse elasticity rule, which is based on first-best analysis.

With respect to the equity effects, the export tax lowers domestic food prices and the real exchange rate. Consequently it benefits nontaxed exportables and the urban households.

III. Policy Conclusions

The major policy conclusions with respect to efficiency, revenue, equity, and international policy coordination are summarized in the paragraphs that follow. The conclusions for tax policy are discussed in general; stabilization tax packages are given particular attention.

• Tax instruments interact with other distortions in the "second-best" economy, and these interactions are important from the standpoint of efficiency. An "efficient" tax package that accounts for other distortions in a heavily distorted economy differs from an efficient tax package that ignores these other distortions.

Therefore, efficient stabilization tax packages should take existing trade distortions into account. Many developing countries rely on trade taxes, which distort international trade. Moreover, in many of these countries fixed prices and distortionary policies, such as overvalued exchange rates, impose implicit taxes that induce additional distortions, including trade distortions.[15] This study has shown that, in the presence of trade distortions, efficient tax packages should avoid implicitly taxing exports. Exports are implicitly taxed through taxes on domestic production, which include domestic and import taxes on intermediate transac-

[15] Dervis, de Melo, and Robinson (1982), for example, show in a general equilibrium study of Turkey that overvalued exchange rates and import rationing induce relatively large efficiency losses, particularly when accompanied by rent seeking. These results suggest that in many developing countries the efficiency losses from implicit taxes dominate the efficiency costs from explicit taxes. For a more general way to model "implicit" taxes in a general equilibrium framework, see Cornielje and Keller (1984).

tions. Thus, efficient tax packages in countries with significant trade distortions should focus on broadly based domestic consumption taxes, thereby avoiding taxes on intermediate transactions. These observations indicate that zero-rating a sector for domestic taxes is more efficient than exempting it from these taxes—particularly when the sector produces goods that are export related, exportable, or import related. In addition, this study has shown that, in the presence of trade distortions, a differential rate structure for domestic taxes—with higher rates for nontradables and exportables and lower rates for import-competing and import-dependent sectors—is more efficient than a uniform rate structure. If explicit and implicit trade taxes are ignored, a uniform rate structure seems more efficient.

Another illustration of the importance of second-best considerations concerns optimal export taxation. Export taxes that raise real national income in a country at the expense of real income of the rest of the world (or world efficiency) may be considered "country-efficient" in the absence of other trade distortions. The same export taxes, however, may not only hurt world efficiency more severely but may also reduce real national income in the home country in the presence of other trade distortions.

• The interaction among taxes, various other economic policies, and distortions is important for revenue. To reach the revenue objectives for a particular tax instrument, other instruments of economic policy need to be supportive. To illustrate, the significant base erosion caused by an import tariff (see Section II, under "Import Tariff") reflects the negative effects of an overvalued exchange rate on tax revenue in countries that heavily depend on trade taxation. An illustration of the interaction among various tax instruments is the revenue effects of the export tax on agricultural commodities. These effects indicate that an economy that heavily relies on trade taxes can be on the downward-sloping segment of the export tax Laffer curve, not only because of the eroding base for the export tax itself, but also because of the additional effect of a depreciating exchange rate on the base of import tariffs.

The base erosion that is induced by trade taxes has important implications for the revenue estimates in stabilization tax packages that raise trade taxes in countries with heavy reliance on such taxes. These revenue estimates should account for the base erosion that is induced by higher trade taxes; ignoring these effects results in seriously overestimating revenue.

• For the objective of equity, the backward shifting of indirect taxes may be as important as, if not more important than, forward shifting—particularly in relation to the distribution between rural and urban sectors. To illustrate, zero-rating investment goods benefits the urban sectors, which depend on earnings from sectors producing investment goods, whereas zero-rating agricultural goods benefits the rural sectors.

Thus rate differentiation, particularly for nontradables with inelastic supply, is ineffective in redistributing income from the demand side. Policies that affect factor prices can, however, be effective in redistributing income from the supply side.

- The sensitivity of gains in national welfare to the price elasticities of export demand reveals an important link between trade policies in industrial countries and tax policy in the developing countries. If export elasticities are large, developing countries benefit in the short run from tax policies (lower import taxes as well as lower explicit and implicit export taxes, including production taxes) that simultaneously improve competitiveness and world efficiency, thereby benefiting the world economy. When export elasticities are small, however, developing countries may suffer short-run welfare losses from tax policies that improve competitiveness and world efficiency. These countries may, therefore, be discouraged from adopting such policies. Because removal of trade barriers by the industrial countries will raise the export elasticities that developing countries face, these nonprotectionist policies provide significant incentives for developing countries to formulate outward-looking supply-side tax policies that benefit themselves as well as the world.

APPENDIX

Algebraic Presentation of the Model

This Appendix contains an algebraic description of the model. Both the description and the model rely heavily on Keller (1980). The model contains 8 household sectors (including the foreign and public households), 13 production sectors (including the investment sector and the Armington sectors), and 25 goods and factors (including the Armington goods and sector-specific capital).

Household Sectors

The column vector q^i_H contains the relative changes in the demands (supplies are measured negatively) of household i for all 25 goods. The household-specific demand functions are given by

$$q^i_H = N^i_H p^i_H + n^i \lambda. \tag{4}$$

Here λ is a scalar representing the relative change in revenue from transaction taxes; for the public household, n^i is the 25-vector of income elasticities; for the nonpublic households, n^i is a 25-vector containing zeros; and N^i_H is a 25×25

matrix of uncompensated price elasticities of household i (defined according to equation (1) of the text).

The symbol p_H^i stands for the 25-vector of relative changes in the after-tax prices facing household i. These prices are related to the relative changes in market prices, which are contained in the 25-vector p_M, and to the changes in the 8 tax instruments, which are contained in the 8-vector t, by the 25×8 matrix T_H^i :

$$p_H^i = p_M + T_H^i t. \tag{5}$$

The 25-vector q_H contains the relative changes in demands of the aggregate household sector, which is found by aggregating over the 8 households:

$$q_H = \sum_{i=1}^{8} \hat{a}_H^i q_H . \tag{6}$$

Here $\hat{a}_H^i$ stands for a diagonal 25×25 matrix with the shares of household sector i in aggregate household demands on its diagonal.

Substituting equations (5) and (4) into equation (6), aggregate household behavior is described by

$$q_H = N_{HM} p_M + N_{HT} t + n\lambda, \tag{7}$$

with

$$N_{HM} = \sum_{i=1}^{8} \hat{a}_H^i N_H^i \tag{8}$$

$$N_{HT} = \sum_{i=1}^{8} \hat{a}_H^i N_H^i T_H^i \tag{9}$$

$$n = \hat{a}_H^p n^p. \tag{10}$$

Here the superscript p represents the public household.

Production Sectors

The column vector q_F^j contains the relative changes in the supplies (demands are measured negatively) of firm j. The firm-specific supply functions are given by

$$q_F^j = N_F^j p_F^j + \iota q_{sj} . \tag{11}$$

Here q_{sj} stands for the output level of firm j, ι is a 25-vector that consists of unit elements, and N_F^j is a 25×25 matrix of uncompensated price elasticities for firm j (defined according to equation (2) of the text).

The symbol p_F^j stands for the 25-vector of the relative changes in after-tax prices facing firm j. These prices are related to the tax instruments by the 25×8 matrix T_F^j :

$$p_F^j = p_M + T_F^j t. \tag{12}$$

The zero-profit condition for firm j is described by

$$c_F^{j'} p_F^j = 0. \tag{13}$$

Here c_F^j is the 25-vector of cost shares of firm j.

The 25-vector q_F contains the relative changes in supplies of the aggregate production sector, which is found by aggregating over the 13 firms:

$$q_F = \sum_{j=1}^{13} \hat{a}_F^j q_F . \tag{14}$$

Here $\hat{a}_F^j$ represents a diagonal 25×25 matrix with the shares of firm j in aggregate firm supplies on its diagonal.

Using equations (11)–(14) allows one to describe aggregate firm behavior by

$$q_F = N_{FM} p_M + N_{FT} t + A_F q_s \tag{15}$$

$$0 = C'_{FM} p_M + C'_{FT} t, \tag{16}$$

with

$$N_{FM} = \sum_{j=1}^{13} \hat{a}_F^j N_F^j \tag{17}$$

$$N_{FT} = \sum_{j=1}^{13} \hat{a}_F^j N_F^j T_F^j \tag{18}$$

and

$$j\text{th column of } C_{FM} = c_F^j \tag{19}$$

$$j\text{th column of } C_{FT} = (T_F^j)' c_F^j \tag{20}$$

$$j\text{th column of } A_F = a_F^j. \tag{21}$$

The symbol a_F^j denotes the 25-vector with shares of firm j in aggregate firm supplies.

To arrive at a closed-form solution for the aggregate firm sector, the 13-vector q_s, which contains the output levels of the firms, is eliminated from equation (15) to arrive at $25 - 13 = 12$ independent equations in q_F. Together with equation (16), these equations yield 25 independent equations for the aggregate production sector.

Equilibrium

Combining the equations for the aggregate household and production sectors with the equilibrium condition

$$q_H = q_F \tag{22}$$

and fixing the world price of the foreign good allows one to solve for the price-vector p_M and total tax revenue λ.

REFERENCES

Armington, P.S., "A Theory of Demand for Products Distinguished by Place of Production," *Staff Papers,* International Monetary Fund (Washington), Vol. 16 (March 1969), pp. 159–76.

Beveridge, W.A., and M.R. Kelly, "Fiscal Content of Financial Programs Supported by Stand-By Arrangements in the Upper Credit Tranches, 1969–78," *Staff Papers,* International Monetary Fund (Washington), Vol. 27 (June 1980), pp. 205–49.

Bovenberg, A.L., "The General Equilibrium Approach: Relevant for Public Policy?," in proceedings of the 41st Congress of the International Institute of Public Finance, Madrid, Spain, August 1985 (Detroit: Wayne State University Press, forthcoming).

———, and W.J. Keller, "Nonlinearities in Applied General Equilibrium Models," *Economics Letters* (Amsterdam), Vol. 14 (February 1984), pp. 53–59.

Cooper, R., and K. McLaren, "The Orani-Macro Interface: An Illustrative Exposition," *Economic Record* (Melbourne), Vol. 59 (June 1983), pp. 166–79.

Cornielje, O.J.C., and W.J. Keller, "Exploring Malinvaud-Type Disequilibrium Models Using Virtual Taxes," Discussion Paper (Amsterdam: Free University of Amsterdam, 1984).

Dervis, K., J. de Melo, and S. Robinson, *General Equilibrium Models for Development Policy* (New York: Cambridge University Press, 1982).

Devarajan, S., and H. Sierra, "Growth Without Adjustment: Thailand, 1973–82" (unpublished; Washington: World Bank, 1985).

Ebrill, L.P., "The Effects of Taxation on Labor Supply, Savings, and Investment in Developing Countries: A Survey of the Empirical Literature" (unpublished; Washington: International Monetary Fund, 1984); revised as "Are Labor Supply, Savings, and Investment Price Sensitive in Developing Countries?," Chapter 3 in *Supply-Side Tax Policy: Its Relevance to Developing Countries,* ed. by V.P. Gandhi and others (Washington: International Monetary Fund, 1987, forthcoming).

Gandhi, V.P., "Vertical Equity of General Sales Taxation in Developing Countries" (unpublished; Washington: International Monetary Fund, 1979).

Goldstein, M., and M.S. Khan, "The Supply and Demand for Exports: A Simultaneous Approach," *Review of Economics and Statistics* (Cambridge, Massachusetts), Vol. 60 (1978), pp. 275–86.

Johansen, L., *A Multi-Sectoral Study of Economic Growth* (Amsterdam: North-Holland, 1960).

Keller, W.J., *Tax Incidence: A General Equilibrium Approach* (Amsterdam: North-Holland, 1980).

Shoven, J., and J. Whalley, "Applied General Equilibrium Models of Taxation and International Trade: Introduction and Survey," *Journal of Economic Literature* (Nashville, Tennessee), Vol. 22 (September 1984), pp. 1007–51.

Tanzi, V., "Quantitative Characteristics of the Tax Systems of Developing Countries" (unpublished; Washington: International Monetary Fund, 1983).